US-PAT-NO: 6602794

DOCUMENT-IDENTIFIER: US 6602794 B1

TITLE: Silylation process for forming contacts

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Abstract Text - ABTX (1):

A method of forming narrow trenches in a layer of photoresist is disclosed. The method includes providing a **photoresist** layer and patterning the **photoresist** layer to form a **plurality of apertures** having sidewalls. The method can also include silylating the sidewalls of the apertures in the photoresist layer and reflowing the photoresist layer. The process can be utilized to form contacts having widths which are less than one lithographic feature wide.

Brief Summary Text - BSTX (13):

Various types of photoresist materials are manufactured by a number of manufacturers. The photoresist material can include multiple photoresist films (i.e. a multi-level resist (MLR)). According to some conventional processes, the photoresist layer is provided over an **anti-reflective** coating (**ARC**), such as silicon nitride (Si.sub.3 N.sub.4) or silicon oxynitride (SiON). The **anti-reflective** coating is disposed above the material which is to be processed.

Detailed Description Text - DETX (6):

Substrate 12 can include a layer of material 14 thereon. Layer of material 14 can be an insulative layer, a conductive layer, a barrier layer, or other layer of material which is to be etched, doped, or layered using the process described herein. In one embodiment, material 14 is a hard mask layer, such as, a silicon nitride layer, a metal layer, or other material. The hard mask layer can serve as a patterned layer for processing of substrate 12 or for processing a layer upon substrate 12. In another embodiment, material 14 is an **anti-reflective** coating (**ARC**). In the preferred embodiment, material 14 is an insulating layer through which a contact is provided. Various integrated circuit features may be fabricated using the method described herein.

Detailed Description Text - DETX (10):

Photoresist material 16 can be a 0.1 micron thick layer of chemically

amplified type photoresist manufactured by Shipley, TOK, Clariant. In one embodiment, material 16 is an ultrathin photoresist layer. Alternatively, material 16 can be DNQ type l-line or g-line photoresist. Material 16 can be provided over an **anti-reflective** coating (**ARC**), or can be a multi-level resist (MLR) material.

Detailed Description Text - DETX (15):

Material 14 can be cleaned and primed before the application of material 16. In addition, an **anti-reflective** coating can be provided above layer 14 before material 16 is applied.

Claims Text - CLTX (16):

16. A method of forming narrow trenches in a layer of photoresist, the method comprising: providing a photoresist layer; patterning the **photoresist** layer to form a **plurality of apertures** having sidewalls; silylating the sidewalls of the apertures in the photoresist layer; and reflowing the photoresist layer.

US-PAT-NO: 6696222

DOCUMENT-IDENTIFIER: US 6696222 B2

TITLE: Dual damascene process using metal hard mask

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Brief Summary Text - BSTX (17):

Still another object of the invention is to provide the dual hard masks as an anti-reflection coating (**ARC**) in subsequent deep ultra violet (DUV) photolithographic operations.

Detailed Description Text - DETX (7):

As shown in FIGS. 2B and 2C, a first **photoresist** layer 42 is patterned on the second hard mask 40 to define a trench of a dual damascene **opening, and then a plurality** of first **openings** 41 are formed in the second hard mask 40 with the first **photoresist** layer 42 as a mask. Next, the first photoresist layer 42 is removed. As shown in FIGS. 2D and 2E, a second **photoresist** layer 44 is patterned on the second hard mask 40 and the first hard mask 38 to define a via hole of a dual damascene **opening, and then a plurality** of second **openings** 43 are formed in the exposed first hard mask 38 with the second **photoresist** layer 44 as a mask. Next, the second photoresist layer 44 is removed. Note that the diameter of the first opening 41 is larger than the diameter of the second opening 43.

Detailed Description Text - DETX (14):

The dual damascene process of this invention has the following advantages: First, the dual hard masks 38 and 40, preferably of metallic materials, are able to prevent oxygen plasma from contact with the low-k dielectric layer 36 when the photoresist layers 42 and 44 are removed. Hence, the gap-filling capacity of subsequently deposited conductive layer 50 in the dual damascene opening 46 can be increased. Second, since the damage to the low-k dielectric layer 36 from the oxygen plasma is avoided, the use of low-k organic materials may be applied to the formation of the low-k dielectric layer 36. This can reduce RC delay and cross talk, and therefore chip size can be scaled down to the next generation. Third, the dual hard masks 38 and 40 can function as an anti-reflection coating (**ARC**) in subsequent deep ultra violet (DUV) photolithographic operations. Since a separate **ARC** is not necessary, production costs are lowered and the dual damascene process is simplified.

Fourth, there is no need to form an etch stop layer inside the low-k dielectric layer 36 in the first embodiment, thus the formation of the low-k dielectric layer 36 is a one-stage operation, such as performing spin-on coating process or CVD process. This further lowers costs and simplifies the dual damascene process.